Exploring the therapeutic potential of lucid dreaming: a comprehensive review of the sleep cycle, dream theory, and nightmare treatment

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Abstract

Sleep is essential for the proper functioning of the mind and body. However, despite its significance there is an aspect of sleep that remains a mystery: dreams, and, more specifically, lucid dreams. This paper compiles an array of research on the sleep cycle, dreaming, lucid dreaming, and lucid dreaming as a therapy for patients struggling with nightmares. Section one discusses the sleep cycle and our slow descent into deep sleep. It reviews the physical indications of each sleep stage, and also mentions how each stage benefits us. Section two aims to explore the physical changes that characterize dreaming, and the functions of dreams through the lens of two theorists, Carl Jung, and Sigmund Freud. Lastly, section three provides an in depth review of lucid dreaming before transitioning into explaining research that has investigated lucid dreaming therapy as an effective treatment for nightmares. There are countless questions surrounding the land of dreams, and more specifically lucid dreams. With further research, harnessing the power of lucid dreaming could cure millions of people who suffer from recurrent nightmares. This research review synthesized various articles and provided evidence that lucid dreaming therapy has reportedly reduced frequency and severity of nightmares. In addition to this, a study showed that lucid dreaming therapy also had the possibility of reducing symptoms of PTSD such as anxiety and depression. Much more research needs to be done in order to confidently say that lucid dreaming therapy is directly responsible for reduced frequency and severity of nightmares, but this possibility opens many doors for lucid dreaming research.

Introduction

Does the key to improving our waking lives lie within our dreams? During sleep, the body enters an altered state of consciousness, where mental, emotional, and sensory experiences occur. Sleep is essential for health. It is directly tied to our memory consolidation, physical growth/repair, etc (Born & Marshall, 2007; Saghir et al., 2018). Lack of sleep can lead to major disruptions in waking life, and can contribute to disorders like epilepsy, schizophrenia, etc. (Rochette et al., 2018). Despite dreaming being a nightly occurrence, this realm of sleep remains largely unexplored, and fundamental questions about the purpose and mechanisms of sleep are unanswered.

Little is known about dreaming, and more specifically altered states of dreaming like lucid dreaming. Lucid dreaming, which occurs during REM sleep, allows the dreamer to become aware of the dream state (Baird et al., 2019). People are very rarely able to lucid dream innately but there are various methods being developed to train this skill (Peters et al., 2023). This sudden gain of consciousness allows the dreamer to somewhat control the content of their dream (Baird et al., 2019). This ability to control the content of your dream has been applied to a technique to improve motor skills while asleep called “mental practice” (Peters et al., 2023). Additionally, researchers have speculated on the potential of lucid dreaming as a therapeutic tool, particularly in treating nightmares (de Macêdo, 2019).

This literature review will discuss the traditional sleep cycle, examining each stage, theories of dreams, and focus on the phenomenon of dreaming. Additionally, it will discuss the unique state of consciousness that is lucid dreaming and what possibilities it could unlock as a treatment.

The Sleep Cycle

While sleeping may appear to be a passive activity, its various functions play an essential role in ensuring our bodies and minds work properly. Sleep plays a significant role in letting regions such as the hippocampus, amygdala, etc repair (Born & Marshall, 2007; Saghir et al., 2018). These regions are responsible for cognitive functions such as short and long-term memory (Born & Marshall, 2007; Saghir et al., 2018).

During sleep, the body undergoes many repeating stages throughout the night, also called the sleep cycle (Schwab, 2024). This process contains 2 main types of sleep: Non Rapid Eye Movement (NREM), and Rapid Eye Movement (REM) (Schwab, 2024). The cycling between these two stages lasts around 90 minutes and, on average, occurs between 4-6 times a night (Schwab, 2024). NREM sleep can be broken down into three sub categories (Schwab, 2024). Each stage is a progressively deeper sleep (Schwab, 2024). The first stage is the lightest sleep stage. During which the sleeper can be woken up fairly easily (Patel et al., 2024). The sleepers' heart rate, brain activity, eye movements, and motor function begin to slow down. When in this stage the brain begins to produce alpha waves. These waves are a common indicator of the transition from wakefulness to sleep (Patel et al., 2024).

In stage 2 of NREM sleep (N2), heart rate, eye movements, brain activity, and motor function continue to slow and body temperature decreases (Patel et al., 2024). The sleeper is less likely to be awakened. During N2 two unique forms of cortical activity occur: sleep spindles, and K-complexes. Sleep spindles are short spikes of brain activity that may be implicated in learning and memory (Alfonsi et al., 2019). Additionally, they help to keep us asleep by blocking external stimuli (Alfonsi et al., 2019). K-complexes consist of a spike of brain activity followed by a negative dip (Gandhi & Emmady, 2021). These serve a similar purpose to sleep spindles helping to keep us asleep, synthesize our memory, and maintain smooth functioning in our brains (Gandhi & Emmady, 2021). However, unlike sleep spindles K-complexes may also wake you up if they perceive dangerous stimuli (Gandhi & Emmady, 2021).

The last stage of NREM sleep is when your heartbeat, breathing, muscle activity, eye movement, and brain waves are at their slowest (Patel et al., 2024). This stage is thought to play the most significant role in our body and brain's regeneration (Patel et al., 2024). During this stage, our bodies release growth hormones which trigger our bodies to begin repairing tissue, muscle, and bone (Patel et al., 2024). Additionally, it is thought to maintain proper functioning of our glucose metabolism, immune systems, hormones, and memory (Patel et al., 2024). Our brain releases delta waves during this stage, the slowest brain waves (Patel et al., 2024). This is considered the deepest sleep stage of the three

previously mentioned. If awakened during this stage the sleeper may experience sleep inertia, which is groggy after being abruptly awakened (Patel et al., 2024). Waking up feeling unrested or fatigued is an indication that you are deprived of this slow wave sleep (Patel et al., 2024).

Overall, physical growth/repair, and memory consolidation can be attributed to NREM sleep (Vahdat et al., 2017). Abnormal NREM sleep is associated with disorders such as schizophrenia (Siclari et al., 2017), epilepsy (Schmitt, 2015), Alzheimer's disease (Lucey et al., 2019), Parkinson's disease (Priano et al., 2019), and even autism spectrum disorders (Rochette et al., 2018). NREM sleep is an essential contributor to our overall health (Rochette et al., 2018).

REM sleep is characterized by the ponto-geniculo-occipital waves which coincide with the rapid eye movements (Siegel, 2001). The REM stage makes up around 25% of the entire sleep cycle (Patel et al., 2024). In this stage the body will experience muscle atonia, which is where skeletal muscles relax, causing (Patel et al., 2024). Additionally, this prevents you from acting out any dreams you are having. REM sleep is considered a more wakeful state of sleep as your brain activity increases in comparison to NREM sleep, and your heart rate and blood pressure more closely mirror that of your wakeful state (Patel et al., 2024). Similar to the function of NREM sleep, REM sleep helps to consolidate your memory and process new information (Peever & Fuller, 2017). This stage plays an important role in retaining new information in your long term memory (Peever & Fuller, 2017).

Overall, sleep is vital to our cognitive function, and improper sleep can cause serious damage to waking life. NREM sleep is crucial to our bodies physical growth/repair, and memory consolidation. REM sleep plays a huge role in our brain's ability to consolidate memories, processing information, and retaining information in your long term memory.

Psychoanalytic Interpretation of Dreams

Scientists have questioned what the function and purpose of dreams might be. These questions emerged in the early 1900' when Sigmund Freud hypothesized that dreams reveal valuable information pertaining to the inner workings of the unconscious mind (Dallett, 1973). However, 100 years later,

scientists still have many unanswered questions concerning dreams, such as do dreams perform a biological function or more of a physiological role? This section will explore the physical changes your body undergoes as you dream, as well as assessing the function of dreams through various different theories on dreams.

There are important physical changes that indicate the sleeper is dreaming, such as, changes in respiration, pulse rate, blood pressure, and muscle activity. Additionally, EEG readings show that during dreams there is a decrease in low frequency activity in the area of our brain responsible for conscious perception (the posterior hot zone) (Siclari et al. 2017). This low amplitude high frequency activity is often observed in Beta and Gamma waves, and usually appears as a pattern of small, rapid oscillations (Siclari et al. 2017).This activity is also observed in REM sleep which supports the belief that dreams primarily occur during REM (Siclari et al. 2017).

It is unknown what the function of dreams are. This is because dreams are very complex, consisting of a subjective nature, excessive brain activity during REM making it hard to isolate brain regions associated with dreaming. For this reason there have been countless theories as to what dreams are but none that are a hundred percent proven. Do they even have a function? The theories this paper will delve into are Freud's "Psychoanalytic theory", and Carl Jung's "Jungian Dream Theory". Both theories agree that dreams are crucial to understanding personality (Roesler, 2020). They differ in that Freud believed dreams repress the unconscious, while Jung believes dreams uncover the unconscious (Roesler, 2020).

Freud's theory on the function of dreams, psychoanalysis, has paved the way for many other contemporary theories on the subject (Dallett, 1973). He believed that dreams are where the wishes of our unconscious minds are fulfilled (Dallett, 1973). He believed that dreams were the key to interpreting conflict within the unconscious mind (Dallett, 1973). Our unconscious mind is able to express the impulses that are repressed by our conscious minds (Dallett, 1973). Freud saw the function of dreams as a way to preserve sleep (Dallett, 1973). Were it not for dreams the energy driven by our unconscious

minds desire would awaken the sleeper (Dallett, 1973). Additionally it serves as a way for our minds to act out those impulses that could otherwise disrupt our waking lives (Dallett, 1973). The reason that the content of dreams is often so chaotic, and uninterpretable is because when unconscious we lack the ability to derive meaning from these symbolic dreams (Dallett, 1973).

Carl Jung's theory, Jungiang Dream Theory argues that dreams uncover our unconscious desires (Dallett, 1973). Although Freud and Jung's theory are similar in this aspect they differ in that Jung believed that dreams are meant to uncover meaning (Dallett, 1973). He believed that dreams are a way for the unconscious mind to communicate with the conscious self (Dallett, 1973). Additionally, while other contemporary theorists argue that dreams emphasize practical functions like go consolidating and problem solving, Jung's theory embraced the irrational side of human nature (Dallett, 1973).

Dreams are a combination of images, emotions, ideas, etc. that occur involuntarily during sleep. There are many physical changes that indicate dreaming such as, changes in respiration, pulse rate, blood pressure, and muscle activity. Additionally, researchers have observed brain activity that indicates dreaming. Many questions concerning dreams and their function remain open ended. Theorists will most likely continue struggling to understand this complex state of consciousness. Both Carl Jung and Freud's theories will continue to influence other scientists' research.

Lucid Dreaming and its Clinical Applications

Lucid dreaming is an altered state of consciousness, occuring in the REM stage, during which the sleeper becomes aware that they are dreaming (Baird et al., 2019). As opposed to the sensation of dreaming which can be described as feeling like you're in the passenger seat of a car, lucid dreaming can be compared to playing a video game (Baird et al., 2019). The sleeper gains the ability to somewhat control the content of the dream given this new state of consciousness (Baird et al., 2019).

Lucid dreaming offers various in dream possibilities, such as flying or dancing, but a more impactful application is its potential to improve 'while awake' motor skills through "mental practice" (Peters et al., 2023). Mental practice is training for a task using mental techniques, such as motor

imagery and no external movements (Peters et al., 2023). Motor imagery is defined as the act of mentally stimulating movements by envisioning yourself performing the task without actually performing them (Peters et al., 2023). Motor imagery is often done in tandem with motor preparation, or the process of the brain preparations to execute the movements needed to complete the intended motor skill (Jeannerod, 2010). Both mental and observable movements engage the same brain regions (Peters et al., 2023). Because mental practice involves the continuous activation of motor networks responsible for carrying out specific actions, scientists believe that it can strengthen neural pathways similarly to how repeatedly performing a motor skill would (Peters et al., 2023). A study was conducted to assess the effectiveness of mental practice on athletes who fast during Ramadan (Fekih et al., 2020). The results of this study suggested that mental practice helped the athletes to enhance their performance and perhaps even counteract the negative effects of the fast (Fekih et al., 2020).

The incredibly immersive, VR-like environment that lucid dreaming provides takes mental practice to a whole new level (Peters et al., 2023). The mental practitioner will feel as if they are truly performing the action because of the realistic sensations of body movement and position that are experienced during lucid dreaming (Peters et al., 2023).

Although, it is unknown how someone has the ability to lucid dream, it may involve the prefrontal cortex, which is larger in patients that can lucid dream (Peters et al., 2023). This fact is congruent with other research that has shown that during lucid dreaming there is an increase in neural activity in the frontal and frontal lateral regions of the brain (Peters et al., 2023). These regions are responsible for higher cognitive functions (reasoning, problem solving, etc.) emotional regulation, speech production, executive functions (self control, attention, working memory, etc.) and spatial orientation (Peters et al., 2023).

The ability to lucid dream innately is rare, however there have been studies that show the skill can be trained (Peters et al., 2023). For example, the Mnemonic Induction of Lucid Dreams, or MILD technique, is based on the idea that rehearsing and visualizing dreams prior to falling asleep with the

intention of becoming lucid and recognising when one is dreaming (Peters et al., 2023). While this method appears simple, it was found that when using the MILD technique in the early morning lucid dreams were much more common in subsequent naps than the night before (Peters et al., 2023). Additionally there is a technique that focuses on reflection and reality (Peters et al., 2023). The subject will ask themselves throughout the day whether they are dreaming or not (Peters et al., 2023). They will observe their environment and check for any discrepancies, as if they were checking whether what they were seeing was real or fake (Peters et al., 2023). The reflection and reality technique also appears to increase the occurrence of lucid dreaming (Peters et al., 2023). The development of these, and other, lucid dream induction techniques can give way to a whole new realm of possibilities for the utilization of this unique state of consciousness (Peters et al., 2023).

Lucid dreaming, in addition to enhancing motor skills, also has clinical applications, such as treating patients suffering with nightmares. Approximately 2-8% of the world, or millions of people, struggle with idiopathic nightmares that greatly reduce sleep quality (Ouchene, 2023). Nightmares do not just affect your quality of sleep but also well-being, waking life, mental health, etc. Lucid dreaming therapy (or LDT) is a practice where you gain consciousness during a nightmare to manipulate the events of the nightmare, and render them normal dreams. This practice can also be applied to the 80% of PTSD patients who suffer from recurrent nightmares (de Macêdo, 2019).

Although more research is needed to confirm the effectiveness of LDT on reducing nightmare frequency, it has been proven to reduce symptoms of nightmares. In a study done on LDT a self-rating questionnaire was administered, before and after LDT, accessing the subjects sleep quality, daytime sleepiness, quality of life, psychological distress, distress caused by traumatic events, mental health, and nightmare severity (de Macêdo, 2019). Although the study failed to find the correlation between LDT and reduction of nightmare severity, this survey showed that levels of anxiety and depression decreased significantly. LDT may not reduce nightmares but is a promising intervention to offset several symptoms of chronic nightmares and PTSD, such as anxiety and depression (de Macêdo, 2019).

Given this information, there have also been multiple cases where LDT has been reported to reduce nightmare frequency and intensity (de Macêdo, 2019). In a case report by Been and Garg in 2010, a 39 year old male with a history of PTSD, and insomnia due to recurrent nightmares spent sixteen days learning about LDT and how to achieve lucidity during nightmares. He successfully neutralized his nightmares by changing them into something enjoyable. His nightmares ceased entirely. Another case report by Abramovitch in 1995 exemplified LDTs effectiveness in treating patients with acute nightmare disorder as well. The subject, a 19 year-old female, received home-based LDT sessions and successfully utilized these techniques to modify her nightmares. These LDT sessions usually entail extensive preparation, for example, setting the intention to gain consciousness during dreaming, common lucid dream induction techniques, such as frequent reality checks to determine whether you are dreaming throughout the day, and post-dream reflections (de Macêdo, 2019).

On a neurobiological level researchers think that LDT works through a suppression of the limbic system through frontal activation (de Macêdo, 2019). The frontal region is responsible for attention span, executive control, decision making etc. While the limbic system is tied to our emotional processes (de Macêdo, 2019). The aspect of dreams that makes them akin to hallucinations, and lacking in rational thought (the ability to distinguish between real life and dreams) could be attributed to the brain activity and neurotransmitter patterns that resemble that of psychosis (de Macêdo, 2019). So when the limbic system, largely responsible for our irrational thought during dreams, is suppressed by frontal activation, responsible for rational thought, judgment etc., it can result in a decrease of nightmare occurrence and severity (de Macêdo, 2019).

Lucid dreaming is the act of gaining consciousness when dreaming, and the sleeper is able to somewhat control the content of the dream (de Macêdo, 2019). The ability to control dream content has proven to be a plausible treatment for patients suffering from nightmares (de Macêdo, 2019). With training the patient could manipulate their nightmares into pleasant, normal dreams (de Macêdo, 2019).

However, much more research needs to be done in order to produce concrete proof that LDT is successful in reducing nightmare frequency and intensity (de Macêdo, 2019).

Discussion

Proper functioning of our minds and bodies rely on our ability to get proper sleep. The benefits of each stage in the sleep cycle are crucial to our waking life as they contribute to things like: memory consolidation (Born & Marshall, 2007), physical growth/repair (Saghir et al., 2018; Vahdat et al., 2017), mental concentration (Saghir et al., 2018; Vahdat et al., 2017), mood regulation (Saghir et al., 2018; Vahdat et al., 2017) etc. Abnormal amounts of sleep have been linked to disorders such as Alzheimer's (Rochette et al., 2018), Parkinson's (Rochette et al., 2018), and even autism spectrum disorders (Rochette et al., 2018). Dreams are also an integral part of sleep. However, the research on the function of dreams is extremely limited. Sigmeund Freud was thought to have pioneered the contemporary theories on dreams (Dallett, 1973). Carl Jeung's theory also continues to influence conversations surrounding dreams (Dallett, 1973). Both theorists believe that dreams are where our unconscious mind is able to express hidden desires, fears, etc (Dallett, 1973). If, one day, the answer to the question concerning the function of dreams is answered, it could potentially lend us a hand in the unconscious mind.

Another aspect of dreams that has many question marks surrounding it is lucid dreaming. This rare ability to gain consciousness during dreams could have endless possibilities. The ability to use the VR-like space that lucid dreaming provides has also been investigated and yielded significant promise (Peters et al., 2023). This, however, is not the most significant possibility that lucid dreaming unlocks. Lucid Dreaming Therapy is being investigated as a treatment for nightmares, which can be especially prevalent in patients with PTSD (de Macêdo, 2019). Although a significant amount of research still needs to be done in order to confirm the effectiveness of this treatment, there is evidence backing up people's claims that it helped to decrease the intensity and frequency of their nightmares (de Macêdo, 2019). If this potential could be harnessed it could help millions whose sleep is plagued by nightmares.

As aforementioned lucid dreaming is a phenomenon closely tied to REM sleep. However, there is data that suggests the claim that lucid dreaming only occurs during REM sleep is false (Stumbrys & Erlacher, 2012). Although many studies hold this claim to be true, one lucid dream induction study (Dane, 1984) reported a significant number of lucid dreams during NREM sleep (Stumbrys & Erlacher, 2012). This study, of 30 hypnotically susceptible women, produced evidence of 3 different types of lucid dreams: unambiguous REM lucid dreams, ambiguous REM lucid dreams, and NREM lucid dreams (Stumbrys & Erlacher, 2012). Each type of lucid dream corresponded to different eye movements (Stumbrys & Erlacher, 2012). There were 48 verified lucid dreams that occurred over the course of one night (Stumbrys & Erlacher, 2012). Of these signal verified results 8 were unambiguous REM lucid dreams (16.7%), 10 were ambiguous REM lucid dreams (20.8%), and finally 30 were NREM lucid dreams (62.5%) (Stumbrys & Erlacher, 2012). This evidence, undeniably, suggests that lucid dreaming can occur in NREM sleep (Stumbrys & Erlacher, 2012).

The distinction between lucid dreaming and dreaming is very interesting. On a surface level the difference between a normal dream and a lucid dream is the ability to gain consciousness (Spoormaker et al., 2014). Non-lucid dreaming can be described as “primary consciousness” in which you are aware of the dream but not that you are dreaming (Spoormaker et al., 2014). Conversely, lucid-dreaming can be referred to as “higher order consciousness” where you are aware you are dreaming, and are able to somewhat control its content (Spoormaker et al., 2014). On a neurobiological level during non-lucid dreams the prefrontal cortex, responsible for higher cognitive functions, is observably less active in comparison to during lucid dreaming (Spoormaker et al., 2014). This is thought to be the reason why we lack skills like logical thinking in dreams (Spoormaker et al., 2014). Whereas, an increase in activity in the prefrontal cortex is thought to be an indication of lucid dreaming (Spoormaker et al., 2014). Our lack of understanding of dreams creates a glaring gap in our knowledge on lucid dreaming.

Conclusions

It is clear that sleep is crucial to the proper cognitive functioning and essential to our waking lives. Scientists debate what and if dreams have the same beneficial functions. Some believe that it could lend helpful insights into the inner workings of our unconscious minds. Lucid dreaming, in particular, has the potential to improve our motor skills and be a treatment for the millions of people suffering from recurring nightmares, such as patients with PTSD. Although studies show promising results, a substantial amount of research is needed to determine the extent of LDT as a therapeutic intervention to reduce frequency and severity of nightmares.

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